

## Central Region Integrated Science Partnership Proposal

**Project Title:** Numerical simulation of the cumulative effects of land-use change and aggregate mines on ground-water flow and wetlands along the South Platte River, Brighton to Fort Lupton, Colorado.

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**Partners/Collaborators and Affiliations:** Colorado Division of Minerals and Geology, U.S. Army Corps of Engineers

**Total Funding Requested:** \$150,000

**Proposal Submission Date:** 12/4/03

**Problem:** The South Platte River valley between the City of Brighton in Adams County and the town of Fort Lupton in Weld County, Colorado, contains many wetland areas that provide habitat for wildlife in the Front Range Urban Corridor. The extent of aggregate mining along this reach of the South Platte River valley continues to increase as the demand for aggregate grows in response to urban development. Furthermore, the presence of aggregate pits can affect the direction of ground-water flow and water levels in the alluvial aquifer adjacent to the South Platte River. Because wetlands are sensitive to changes in ground-water levels, the hydrologic effects of aggregate pits also may affect vulnerable wetlands near pits. Changes in land use and land cover can have significant influence on economic and environmental quality at multiple scales, and mapping land-use changes is fundamental to the health and viability of the Nation's natural and developed environments. A study of the cumulative effects of land-use change and aggregate mining on ground-water flow and wetlands is needed to provide information useful to planning and regulating aggregate mine sites so effects on wetlands and wildlife may be minimized while meeting aggregate resource needs.

**Objective:** The project goals are to improve understanding of landscape change and provide scientific information concerning the potential effects of land-use change and aggregate mining on ground-water flow and wetlands.

**Scope:** The study objective will be accomplished by completing the following specific tasks for the South Platte River Valley from the City of Brighton in Adams County to the town of Fort Lupton in Weld County, Colorado.

- 1) Land-use, land-cover, and socioeconomic data will be compared and analyzed for different time periods to improve understanding of the kinds and locations of changes that are taking place, their root causes, and the rate at which changes are occurring.
- 2) The effects of land-use change on aquifer recharge will be analyzed and used to demonstrate the effects of land-use change on ground-water flow and wetlands.
- 3) The cumulative effects that multiple lined and unlined aggregate pits may have on ground-water flow and wetlands will be demonstrated.
- 4) Areas where water-level declines caused by land-use change or aggregate pits may affect existing vulnerable wetlands will be indicated.
- 5) Areas where water-level rises caused by land-use change or aggregate pits may alter existing wetlands or create conditions favorable to wetlands development will be indicated.
- 6) Wetland designations used in existing land-use and land-cover data will be validated.

**Approach:** Task 1 will be accomplished by comparing and analyzing temporal high resolution land-use and land-cover data from 1957, 1977 and 2000. Socioeconomic data such as population density, housing density, and aggregate resource development will be incorporated to understand the rates, causes, and consequences of development and simulate future scenarios for landscape change.

Tasks 2 through 5 will be accomplished by using the U.S. Geological Survey's Modular Ground-Water Model to construct a numerical ground-water flow model of the alluvial aquifer in the study area. The model will simulate steady-state ground-water flow in the aquifer under 1) land-use conditions in 1957 prior to the development of extensive aggregate mining, 2) land-use conditions in 1977, 3) land-use conditions in 2000, and 4) two future land-use and mining conditions predicted on the basis of historical trends. The effects of both lined and unlined pits refilled with water after mining will be simulated. The numerical ground-water flow model will be constructed by the Water Resources Discipline. Land-use and land-cover data provided by the Geography Discipline will be input to the model and used to compare aquifer recharge at different times. Lithology of the aquifer in the study area will be mapped by the Geologic Discipline and used to determine aquifer properties for input to the ground-water model. The effects of water-level changes on wetland biota will be estimated by the Biological Resources Division.

Task 6 will be accomplished by identifying key wetland species and soil types in field areas indicated as wetlands on existing land-use and land-cover maps. Identified wetlands will be compared to existing maps, and techniques for improving the classification of wetlands will be investigated.

**Benefits:** The proposed study involves integrated science between the USGS Disciplines of Geology, Water Resources, Geography, and Biological Resources. The study addresses the Director's Annual Program Direction theme of Restoration and Recovery of Impaired Ecosystems and the theme of Water for Humans and Ecological Use. The study also addresses the Central Region Science Priorities of Urban Dynamics / Landscape Change and Ground Water. The U.S. Environmental Protection Agency has identified wetlands protection as a priority issue, and partnerships between the USGS and the U.S. Army Corps of Engineers (USACE) and Colorado Division of Minerals and Geology (CDMG) have been formed. Central Region Integrated Science Partnership funding would be leveraged with in-kind services by USACE and CDMG to provide information of great interest to a variety of customers. The results of the study would 1) support assessments of land-use change being conducted by the Geography Discipline under the Geographic Analysis and Monitoring program, 2) provide information useful to decision makers in the aggregate permitting process concerning the effects of lined and unlined pits on vulnerable wetlands, and 3) improve classification of wetlands on land-use/land-cover maps.

**Outcome/Products:** A USGS Water-Resources Investigations Report documenting the ground-water flow model and presenting simulation results will be produced. In addition, a USGS Geography report will present results of the land-use/land-cover classification assessment, recommendations for classification rules modification, and maps.

**Budget:** Project expenditures are expected to be primarily labor for data collection and analysis, model construction, model calibration, and predictive simulations. Other expenditures include travel, supplies, and printing.

Geology Discipline: \$0

Water Resources Discipline: \$50,000/year for 2 years

Geography Discipline: \$14,000/year for 2 years

Biological Resources Discipline: \$11,000/year for 2 years

**Timeline:**

FY04: Compile land-use data, map aquifer lithology, collect and compile hydrologic data, assess wetlands based on key wetland plant species.

FY05: Analyze land-use data, construct and calibrate numerical model, execute simulations, identify net loss or gain in wetlands, write reports.